

REMARKS

1. Posture of the Case

This is a first reply to the first Office action in the case.

Figures 1 and 2 stand in need of correction because they should be designated by a legend such as "Prior Art."

Claims 3, 4, 8, 9, 10, and 14 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Examiner cites insufficient antecedent basis for reciting "the group of heuristics" in claims 3, 9, and 14, reciting "the group of schedulers" in claims 4 and 10, and reciting "said table" in claim 8.

Claims 1 through 6 and 11 through 14 are rejected under 35 U.S.C. 102(e) as being anticipated by Ofer et al. (6,904,470).

Claims 7 through 10 and 15 through 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ofer as applied to claims 1 through 6 and 11 through 14 in view of Structured Computer Organization Second Edition by Andrew S. Tanenbaum.

2. Amendments herein

Claims 5-7 and 18 are herein canceled. Claims 1, 8, 16 and 17 are herein amended to overcome the rejection of those claims. No new matter is added herein, since the original specification provides support for the amendments. Present application, page 9, lines 6-9 (mapping by an operating system kernel); page 13, line 19 - page 14, line 22 (a set of heuristic variables H1 - H4 for characterizing performance states of the computing system, including variable H1 for a number of I/O job requests as a proportion of a total number of processes requesting I/O jobs, variable H2 for a number of read operations as a proportion of total number of read and write operations, and variable H4 for an average disk seek distance of submitted job requests); Table 1, page 16, lines 13-15 (a first one of the heuristic sets, i.e., "anticipatory" row in Table 1, defining a first performance state of the computer system, wherein a certain predefined high proportion of read operations is exceeded for the second variable (H2) and a certain predefined average seek distance is not exceeded for the third variable (H4)); id. (a second one of

the heuristic sets, "FIFO" row in Table 1, defining a second performance state of the computer system, wherein a certain predefined high level of I/O job requests per process is exceeded for the first variable (H1), a certain predefined low proportion of read operations is not exceeded for the second variable (H2), and the certain predefined average seek distance is not exceeded for the third variable (H4)); id. (a third one of the heuristic sets, i.e., "fairness" row in Table 1, defining a third performance state of the computer system, wherein the certain predefined high level of I/O job requests per process is exceeded for the first variable (H1) and the certain predefined low proportion of read operations is exceeded but the certain predefined high proportion of read operations is not exceeded for the second variable (H2)); page 12, lines 5-31 and pages 16, line 19-page 17, line 11 (first, second and third input/output schedulers); page 13, lines 19-21 and Table 1, page 16 (operating system kernel associating the first one of the heuristic sets with the first scheduler, the second one of the heuristic sets with the second scheduler and the third one of the heuristic sets with the third scheduler); page 9, lines 17-24 (a thread of the operating system kernel monitoring performance values of the heuristic variables); page 16, lines 7-12 and Table 1 (selecting one of the anticipatory, FIFO, or fairness input/output schedulers by the operating system kernel thread, wherein the selecting is responsive to the operating system kernel thread determining that a performance state of the computer system is such that values of said monitored heuristic variables match one of said first, second or third sets of heuristics). See item 3 below for discussion of "mutually exclusive," as stated in claim 16.

Claims 2, 3, and 9 are herein amended to conform to the amendments of their respective independent claims. See also page 16, lines 7-12 and Table 1 (selecting a default input/output scheduler from said plurality of input/output schedulers, when said monitored heuristics do not match any of said desired sets of heuristics).

Claims 4 and 10 are also herein amended, and claim 19 is herein added, to more particularly point out that the first input/output scheduler schedules input/output operations responsive to an anticipatory scheduling algorithm, the second input/output scheduler schedules responsive to a first in first out algorithm by, and the third input/output scheduler schedules responsive to a fairness queue algorithm. No new

matter is added herein, since the original specification provides support for the amendments. Present application, page 12, lines 5-31 and pages 16, line 19-page 17, line 11.

3. Issues presented

The cited art does not teach or suggest mutually exclusive heuristic sets defining respective, mutually exclusive performance states of a computing system, as particularly pointed out in the claims amended herein.

As stated in the present application, "The embodiments of the present invention exploit the fact that the conditions under which each of these schedulers provides best results are mutually exclusive." Present application, page 16, lines 19-20. Accordingly, amended claim 1, for example, specifically states that a first one of the heuristic sets defines "a first performance state of the computer system, wherein a certain predefined high proportion of read operations is exceeded for the second variable and a certain predefined average seek distance is not exceeded for the third variable." (Claims 8 and 17 have similar language.) This is inherently a mutually exclusive performance state with respect to a second performance state of the computer system defined by a second one of the heuristic sets because the second one of the heuristic sets, as claimed, defines "a second performance state of the computer system, wherein a certain predefined high level of I/O job requests per process is exceeded for the first variable, a certain predefined low proportion of read operations is not exceeded for the second variable, and the certain predefined average seek distance is not exceeded for the third variable." The first and second performance states are also mutually exclusive of a third performance state of the computer system defined by a third one of the heuristic sets because the third one of the heuristic sets, as claimed, defines "a third performance state of the computer system, wherein the certain predefined high level of I/O job requests per process is exceeded for the first variable and the certain predefined low proportion of read operations is exceeded but the certain predefined high proportion of read operations is not exceeded for the second variable." The cited art does not teach or suggest these features of the amended claims.

The cited art does not teach or suggest mapping of heuristic sets with respective input/output schedulers and selecting one of a plurality of input/output schedulers by an operating system kernel, as particularly pointed out in the claims amended herein.

The Office action cites Tanenbaum for the proposition that hardware features may be implemented in software. However, a conventional arrangement, as described in the Background of the present application, concerns an operating system kernel (which is software) submitting job requests to an I/O scheduler, which is a component residing between a core kernel layer/file system layer and various drivers (also software). See, e.g., present application, page 1, lines 16-32. In contrast, amended claim 1, for example, now specifically states that mapping is done *by an operating system kernel*, including the operating system kernel associating the respective heuristic sets with the respective input/output schedulers. Likewise, claim 1, for example, now specifically states that *the operating system kernel thread* selects one of the input/output schedulers responsive to determining that a performance state of the computer system is such that values of said monitored heuristic variables match one of said first, second or third sets of heuristics. (Claims 8 and 17 have similar language, according to the respective forms of the invention they claim.)

Applicant contends that there is no issue, according to these claims in the present application, regarding implementing in software that which has conventionally been a hardware feature. That is, there is no teaching cited and relied upon by the Office action about hardware associating respective heuristic sets with respective input/output schedulers, as claimed. Accordingly, a teaching by Tanenbaum that something which has conventionally been a hardware feature may be implemented in software does not teach or suggest, in combination with Ofer, about *an operating system kernel* associating respective heuristic sets with respective input/output schedulers, as claimed. Nor does Tanenbaum in combination with Ofer teach or suggest that *an operating system kernel thread* selects one of the input/output schedulers responsive to determining that a performance state of the computer system is such that values of said monitored heuristic variables match one of said first, second or third sets of heuristics, as claimed.

In a similar fashion, the preamble of original claim 11 states “*An operating system kernel in a computing system, said operating system kernel comprising.*” The claim goes on to state that it is the *operating system kernel* that includes “means for maintaining . . . values associated with . . . schedulers; means for monitoring . . . and means for comparing . . . to select one of said . . . schedulers.” For the same reasons as stated immediately above, Tanenbaum in combination with Ofer do not teach or suggest that *an operating system kernel thread* includes “means for maintaining . . . values associated with . . . schedulers; means for monitoring . . . and means for comparing . . . to select one of said . . . schedulers,” as claimed.

In a similar fashion, amended claim 16 states that a claimed computing system includes “a heuristics module in an operating system kernel of the computing system, the heuristics module being operable for analysing information returned from said hardware device drivers module relating to said executed job requests.” Further, amended claim 16 further states that the system includes “a switch module in an operating system kernel of the computing system, the switch module being operable for comparing said analysed information with predetermined, mutually exclusive sets of heuristic values to identify one of the mutually exclusive sets of heuristic values for switching said active input/output scheduler in said input/output scheduling module to a selected one of said input/output schedulers, wherein the selected one of the input/output schedulers corresponds to the identified one of the mutually exclusive sets of heuristic values.” For the same reasons as stated immediately above, Tanenbaum in combination with Ofer do not teach or suggest that “a switch module in an operating system kernel of the computing system” is “operable for . . . to identify one of the mutually exclusive sets of heuristic values for switching said active input/output scheduler in said input/output scheduling module to a selected one of said input/output schedulers, wherein the selected one of the input/output schedulers corresponds to the identified one of the mutually exclusive sets of heuristic values,” as claimed.

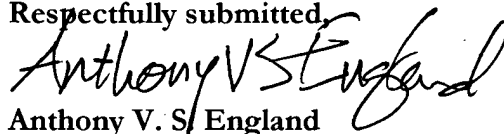
PRIOR ART OF RECORD

Applicant has reviewed the prior art of record cited by but not relied upon by Examiner, and asserts that the invention is patentably distinct.

REQUESTED ACTION

For the above reasons, Applicant contends the invention as in the claims set forth herein above is patentably distinct. Applicant requests that Examiner grant allowance and prompt passage of the application to issuance.

Respectfully submitted,



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IN THE DRAWINGS

Examiner's Office communication of January 3, 2006, pointed out that Figures 1 and 2 should be designated by a legend such as "Prior Art." Herein submitted are replacement sheets 1 and 2 to be substituted for the originally filed Figures 1 and 2. In the replacement sheets the legend "Prior Art" has been added.